

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

1. (Currently amended) A method of simulating a system, comprising:
establishing equations modeling the system using terms having characteristics encapsulated within the ~~term~~ terms;
performing symbolic processing on the established equations for simplification; and
performing system processing ~~on the established equations~~ for efficient simulation,
wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations.

2. (Original) The method of claim 1, wherein the stage of defining equations further includes:
defining equations modeling the system using terms selected from one or more basic terms, composite terms, or collection terms.

3. (Original) The method of claim 1, further including:
extending a library of terms by defining new term classes, wherein term classes define objects having characteristics encapsulated within the objects.

4. (Original) The method of claim 1, further including:
defining a term group including one or more terms having related functionality;
evaluating each term within the term group upon an initial request for evaluation of any
of the one or more terms within the term group;
storing the result of the evaluation for each of the one or more terms within the term
group; and
recalling the stored value of the evaluated one or more terms from the term group upon a
subsequent request for evaluation of the one or more terms, without performing the evaluation
stage.

5. (Original) The method of claim 1, wherein the symbolic processing stage
further includes reducing the established equations, utilizing the Pantelides algorithm, to a
system of equations having a differential-algebraic system of equations index of at most one.

6. (Original) The method of claim 5, wherein utilizing the Pantelides algorithm
further includes:
assigning equations to variables that have non-zero partial derivatives; and
differentiating the remainder of the equations.

7. (Currently amended) The method of claim 5, wherein utilizing the Pantelides algorithm further includes:

approximating an algebraic derivative for those equations that cannot ~~by~~ be symbolically differentiated.

8. (Original) The method of claim 5, wherein utilizing the Pantelides algorithm further includes:

symbolically integrating equations that cannot be assigned.

9. (Original) The method of claim 5, wherein utilizing the Pantelides algorithm further includes:

differentiating equations that add output derivatives and integrating equations that add output integrals.

10. (Original) The method of claim 5, wherein utilizing the Pantelides algorithm further includes:

eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship.

11. (Original) The method of claim 10, wherein eliminating an integral further includes:

assigning a preferred integration location rank to one or more integrals;
utilizing the preferred integration location rank, assigning integrals to equations; and
eliminating the integration of assigned or solved integral variables.

12. (Original) The method of claim 11, wherein assigning a preferred integration location rank further includes:

assigning a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;

assigning a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and

assigning all other integration locations a default lowest rank.

13. (Original) The method of claim 12, wherein the assigned preferred integration location is assigned by a user.

14. (Original) The method of claim 12, wherein the assigned preferred integration location rank is assigned by a component developer.

15. (Original) The method of claim 12, wherein utilizing the preferred integration location ranks to assign integrals to equations further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations;

establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank, and, if possible, appears linearly in the equation; and

repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

16. (Original) The method of claim 15, further including:

solving each integral equation that is assigned an integral that appears linearly in it;

substituting the solved value into other equations; and

if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

17. (Currently amended) The method of claim 1, wherein the stage of performing system processing ~~on the established equations~~ further includes:

establishing performing system processing on an initial condition system using the first set of equations and establishing apart from performing system processing on a transient system using the second set of equations.

18. (Currently amended) The method of claim 17 ~~1~~, ~~further including wherein~~
processing a first set of equations includes:

~~defining user defined and component defined initial condition equations for the initial~~
~~condition system~~ processing a first set of equations including equations modeling the system and
user-defined and component-defined initial condition constraints.

19. (Currently amended) The method of claim 17 ~~1~~, ~~further including wherein~~
performing system processing includes:

~~defining numeric integration equations for the transient system~~ performing the system
processing on the first set of equations and the second set of equations independently and in
parallel.

20. (Original) The method of claim 1, wherein system processing further
includes:

replacing alias variables;
partitioning the equations into blocks;
tearing the blocks;
sorting the blocks; and
compressing equation terms.

21. (Original) The method of claim 20, wherein tearing the equations includes:

- identifying block variables in the equations in the block in which the block variables appear linearly with constant coefficients;
- solving nonlinear integration equations for their respective integrals;
- solving the linear equations;
- determining the solvability of the nonlinear equations;
- solving the nonlinear equations utilizing iterates and block variables solved from the linear equations; and
- scanning the solved variables for identification of variables that are independent and may be removed from the block.

22. (Original) The method of claim 20, wherein block sorting further includes:

- defining and identifying the blocks as static blocks, dynamic blocks, or output blocks;
- removing the static blocks from a list of blocks; and
- removing the output blocks from the list of blocks.

23. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of simulating a system, the method comprising:

defining equations modeling the system using terms having characteristics encapsulated within the ~~term~~ terms;

performing symbolic processing on the established equations for simplification; and

performing system processing ~~on the established equations~~ for efficient simulation, wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations.

24. (Original) The machine-readable storage medium of claim 23, wherein the stage of defining equations further includes:

defining equations modeling the system using terms selected from one or more basic terms, composite terms, or collection terms.

25. (Original) The machine-readable storage medium of claim 23, further including:

extending a library of terms by defining new term classes, wherein term classes define objects having characteristics encapsulated within the objects.

26. (Original) The machine-readable storage medium of claim 23, further including:

- defining a term group including one or more terms having related functionality;
- evaluating each term within the term group upon an initial request for evaluation of any of the one or more terms within the term group;
- storing the result of the evaluation for each of the one or more terms within the term group; and
- recalling the stored value of the evaluated one or more terms from the term group upon a subsequent request for evaluation of the one or more terms, without performing the evaluation stage.

27. (Original) The machine-readable storage medium of claim 23, wherein the symbolic processing stage further includes reducing the established equations, utilizing the Pantelides algorithm, to a system of equations having a differential-algebraic system of equations index of at most one.

28. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

- assigning equations to variables that have non-zero partial derivatives; and
- differentiating the remainder of the equations.

29. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

approximating an algebraic derivative for those equations that cannot be symbolically differentiated.

30. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

symbolically integrating equations that cannot be assigned.

31. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

differentiating equations that add output derivatives and integrating equations that add output integrals.

32. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship.

33. (Original) The machine-readable storage medium of claim 32, wherein eliminating an integral further includes:

- assigning a preferred integration location rank to one or more integrals;
- utilizing the preferred integration location rank, assigning integrals to equations; and
- eliminating the integration of assigned or solved integral variables.

34. (Original) The machine-readable storage medium of claim 33, wherein assigning a preferred integration location rank, further includes:

- assigning, by a user, a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;

- assigning, by a component developer, a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and

- assigning all other integration locations a default lowest rank.

35. (Original) The machine-readable storage medium of claim 34, wherein utilizing the preferred integration location ranks to assign integrals to equations, further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations;

establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank and, if possible, appears linearly in the equation; and

repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

36. (Original) The machine-readable storage medium of claim 35, further including:

solving each integral equation that is assigned an integral that appears linearly in it;

substituting the solved value into other equations; and

if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

37. (Currently amended) The machine-readable storage medium of claim 23, wherein the stage of performing system processing ~~on the established equations further~~ includes: establishing ~~performing system processing on~~ an initial condition system using the first set of equations and establishing apart from performing system processing on a transient system using the second set of equations.

38. (Currently amended) The machine-readable storage medium of claim ~~37~~ 23, ~~further including~~ wherein processing a first set of equations includes:
defining user defined and component defined initial condition equations for the initial condition system processing a first set of equations including equations modeling the system and user-defined and component-defined initial condition constraints.

39. (Currently amended) The machine-readable storage medium of claim ~~37~~ 23, ~~further including~~ wherein performing system processing includes:
defining numeric integration equations for the transient system performing the system processing on the first set of equations and the second set of equations independently and in parallel.

40. (Original) The machine-readable storage medium of claim 23, wherein system processing further includes:

- replacing alias variables;
- partitioning the equations into blocks;
- tearing the blocks;
- sorting the blocks; and
- compressing equation terms.

41. (Original) The machine-readable storage medium of claim 40, wherein tearing the block includes:

- identifying block variables in the equations in the block in which the block variables appear linearly with constant coefficients;
- solving nonlinear integration equations for their respective integrals;
- determining the solvability of the nonlinear equations;
- solving the nonlinear equations utilizing iterates and block variables solved from the linear equations;
- solving the linear equations; and
- scanning the solved variables for identification of variables that are independent and may be removed from the block.

42. (Original) The machine-readable storage medium of claim 40, wherein block sorting further includes:

defining and identifying the blocks as static blocks, dynamic blocks, or output blocks;

removing the static blocks from a list of blocks; and

removing the output blocks from the list of blocks.

43. (Currently amended) A method of ~~symbolically processing a set of equations simulating systems~~, comprising:

symbolically processing a set of equations, including:

assigning a portion of the set of equations to variables that have non-zero partial derivatives;

differentiating the remainder of the set of equations;

approximating an algebraic derivative for those equations that cannot be symbolically differentiated;

symbolically integrating equations that cannot be assigned;

differentiating equations that add output derivatives and integrating equations that add output integrals; and

eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship; and

generating a system for simulation using the symbolically processed set of equations.

44. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of ~~symbolically processing a set of equations~~ simulating systems, the method comprising:

symbolically processing a set of equations, including:

assigning a portion of the set of equations to variables that have non-zero partial derivatives;

differentiating the remainder of the set of equations;

approximating an algebraic derivative for those equations that cannot be symbolically differentiated;

symbolically integrating equations that cannot be assigned;

differentiating equations that add output derivatives and integrating equations that add output integrals; and

eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship; and

generating a system for simulation using the symbolically processed set of equations.

45. (Currently amended) A method of eliminating an integral in a Pantelides algorithm performed by a computer-based application that simulates a system, comprising:

assigning a preferred integration location rank to one or more integrals;

utilizing the preferred integration location rank, assigning integrals to equations; and

eliminating the integration of assigned or solved integral variables.

46. (Original) The method of claim 45, wherein assigning a preferred integration location rank, further includes:

assigning, by a user, a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;

assigning, by a component developer, a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and

assigning all other integration locations a default lowest rank.

47. (Original) The method of claim 46, wherein utilizing the preferred integration location ranks to assign integrals to equations, further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations;

establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank and, if possible, appears linearly in the equation; and

repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

48. (Original) The method of claim 47, further including:
solving each integral equation that is assigned an integral that appears linearly in it;
substituting the solved value into other equations; and
if due to substitutions, an one of the assigned variables is no longer in the equation,
assign another integral with minimum integration rank to the one of the assigned variables.

49. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of eliminating an integral in a Pantelides algorithm used by an application that simulates a system, the method comprising:

assigning a preferred integration location rank to one or more integrals;
utilizing the preferred integration location rank, assigning integrals to equations; and
eliminating the integration of assigned or solved integral variables.

50. (Original) The machine-readable storage medium of claim 49, wherein assigning a preferred integration location rank, further includes:

assigning, by a user, a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;

assigning, by a component developer, a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and

assigning all other integration locations a default lowest rank.

51. (Original) The machine-readable storage medium of claim 50, wherein utilizing the preferred integration location ranks to assign integrals to equations, further includes:

- identifying integral variables that appear linearly and nonlinearly in the integral equations;
- establishing a current preferred integration location rank at a default setting;
- assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank and, if possible, appears linearly in the equation; and
- repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

52. (Original) The machine-readable storage medium of claim 51, further including:

- solving each integral equation that is assigned an integral that appears linearly in it;
- substituting the solved value into other equations; and
- if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

53. (Currently amended) A method of ~~tearing equations~~ simulating systems, comprising:

performing a tearing process on a set of equations, including:

identifying block variables in the equations in a block in which the block variables appear linearly with constant coefficients;

determining the solvability of the nonlinear equations;

solving nonlinear integration equations for their respective integrals;

solving the linear equations;

solving the nonlinear equations utilizing iterates and block variables solved from the linear equations; and

scanning for solved for variables for identification of variables that are independent and may be removed from the block; and

generating a system for simulation using the processed equations.

54. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of ~~tearing blocked equations~~ simulating systems, the method comprising:

performing a tearing process on a set of equations, including:

identifying block variables in the equations in a block in which the block variables appear linearly with constant coefficients;

solving nonlinear integration equations for their respective integrals;

solving the linear equations;

determining the solvability of the nonlinear equations;

solving the nonlinear equations utilizing iterates and block variables solved from the linear equations; and

scanning for solved for variables for identification of variables that are independent and may be removed from the block; and

generating a system for simulation using the processed equations.

55. (Currently amended) A method of simulating a system, comprising:
establishing equations modeling the system using terms having characteristics encapsulated within the ~~term~~ terms;
performing symbolic processing on the established equations for reducing the number of terms in the equations; and
performing system processing ~~on the established equations~~ for efficient simulation, wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations.

56. (Original) The method of claim 55, further including:
defining a term group including one or more terms having related functionality;
evaluating each term within the term group upon an initial request for evaluation of any of the one or more terms within the term group; and
storing the result of the evaluation fro each of the one or more terms within the term group.

57. (Original) The method of claim 56, further including:
recalling the stored value of the evaluated one or more terms from the term group upon a subsequent request for evaluation of the one or more terms, without performing the evaluation stage.

58. (Currently amended) A method of simulating a component, comprising:
establishing equations modeling the component using terms having characteristics encapsulated within the ~~term~~ terms;
performing symbolic processing on the established equations for simplification; and
performing system processing ~~on the established equations~~ for efficient simulation,
wherein performing system processing includes processing a first set of equations including equations modeling the component and initial condition constraints and processing a second set of equations including equations modeling the component and numeric integration equations.

59. (New) A method of simulating a system, comprising:
establishing equations modeling the system;
performing symbolic processing on the established equations for simplification;
establishing a first set of equations including equations modeling the system and initial condition constraints;
establishing a second set of equations including equations modeling the system and numeric integration equations that constrain integrated variables; and
processing the first and second sets of equations independently and in parallel, to generate initial condition and transient solutions.

60. (New) The method of claim 59, wherein establishing equations modeling the system comprises establishing component equations, connectivity equations, and boundary condition equations; and wherein each of the first and second set of equations includes component, connectivity, and boundary condition equations.